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Management System Study on Large Hydropower Station Reservoirs Groups in Upper Yangtze River

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Abstract

The main problems about the management system of the large hydropower station reservoir groups are clarified based on the current situation analysis of the water energy development in the upper Yangtze River, including unclear division of management functions, utilizing conflict existing in the relative aspects of hydraulic programs, incompleteness of current tax system, electrovalence system and the electric scheduling distribution system is not conducive to the development of hydropower. A set of complete management system of the large hydropower reservoir groups is put forward according to eight aspects. They are high-level coordination mechanism for constructing the development of the hydropower reservoir groups in upper Yangtze River, building the basin integrated management system in favor of the reservoirs development in upper Yangtze River, constructing and completing the regulation and policy systems as well as the efficient operation in favor of the hydropower reservoirs safety in upper Yangtze River. It provides the useful reference for building the management system of basin hydropower reservoirs.

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Keywords: upper Yangtze River, water energy development, hydropower reservoir groups, management system

1. Introduction

Water energy is clean renewable energy. The development and utilization of it is regarded seriously by many countries. For example, the hydropower proportion of Norway is the highest in the world, it is about

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98.9%. As the construction of large-scale hydropower, the management of hydropower reservoirs becomes the focus of attention.

There are more mature hydropower reservoirs management in foreign countries like Tennessee River and Columbia River in the United States, the scheduling management of the cascade hydropower reservoirs of Hydropower Company in Quebec of Canada. The common feature of these management organizations is that the real basin controlling center is established. It takes the routine scheduling and plan into centre. The company has the decision-making rights about the basin scheduling. The independent basin scheduled centre is established. It manages the hydropower convection and cross-basin.

In China, hydropower development comes through four stages as the command model of the traditional planned economic system, the owner responsible model of the market economic system, the comprehensive development mechanism model and mixed ownership stock companies model^[1]. In the 21st century, there are profound changes in electric system and investment system in China. The degree of hydraulic marketization is increasing, the energy supply situation is changing, the macro-management of hydropower development and relevant laws has lagged far behind, and it affects the health and sustainable of hydropower. Therefore, the management system of hydropower reservoirs has been the focus. Three Gorges project of the upper Yangtze River is the largest water control pivot in the world. It seems to be particularly urgent to study the management system of large hydropower reservoirs in upper Yangtze River.

2. Development Status of Hydropower in Upper Yangtze River

The water resource of Yangtze Basin is the largest in the world, the water resource can be developed is 1.97kW, it is almost 53.4% of the whole country. In prediction, the reservoir capacity of the Yangtze River tributaries will reach 135.7 billion m³, the regulating storage will reach 72.6 billion, installed capacity will reach 105.49 million kW before 2002. There are five bases located the upper Yangtze River in the thirteen planned hydropower bases. They are Jinsha River, Yalong River, Dadu River, Wujiang and upper Yangtze River hydropower base. There are 34 built and building large hydropower stations and more than 30 large hydropower stations will be built. The main stream and main tributary are considered to be the hydropower base. At present, power is active demanded in our country, hydropower development is widely concerned. And the economy of many areas develops quickly, the huge amounts of social money follows into the hydraulic market; it accelerated the process of hydropower development. The recent ten years is the peak of the river cascade development. The hydraulic layout of main river cascade will be complete before 2020^[2]. The main large hydropower stations are listed in Table 1.

Table 1 Main Large Hydropower Stations

Num ber	Name of River	Name of Hydropower station
1	Jinsha River	Hutiaoxia, Liyuan, Ahai, Jinan Bridge, Longkaikou, Ludila, Guanyinyan, Wudongde, Xiluodu, Xiangjiaba
2	Yalong River	Lianghekou, Yageng, Mengdigou, Yangfanggou, Jingping first-step, Jingping second-step, Guandi, Ertan, Daqiao
3	Dadu River	Shuangjiangkou, Danba, Houziyan, Changheba, Lengzhuguan, Dagangshan, Longtoushi, Pubugou, Gongzui, Tongjiezi
4	Mingjiang	Zipingpu, Heilongtan
5	Tuojiang	Sancha
6	Fujiang	Luban
7	Jialingjiang	Bikou, Baozhushi, Jingyingtai, Xinzheng, Jinxichang, Mahui, Fengyichang, Xiaolongmen,

		Qinju, Dongxiguan, Tongzihao, Shengzhong
8	Qujiang	Jiangkou
9	Wujiang	Hongfeng, Hongjiadu, Dongfeng, Wujiangdu, Goupitan, Siling, Shatuo, Pengshui, Jiangkou, Dahekou
10	Main Stream of upper Yangtze River	Shipeng, Zhuyangxi, Xiaonanhai, Three Georges Dan, Gezhou Dan, Geheyan, Gaobazhou, Shuibuya

3. Exiting problem in the management of hydropower station in upper Yangtze River

There are many hydropower stations and reservoirs in main and tributaries of upper Yangtze River.; the development scale is very large; the density of cascade is very large. The joint operation of large hydropower station involves optimal allocation of water resources, flood control, water ecology, water environment, sediment, river trend and many other natural sciences. It also involves economic development, market competition, coordination mechanisms, political rules and other economic social fields. It is a very complex huge system^[3]. At present, there are main problems in the management of large hydropower reservoirs in upper Yangtze River:

3.1. Function of manage departments are not divided clearly.

While the large hydropower stations are development, it will involve multiple departments in both at the central level and the local level. From the central level, the departments which are related with hydropower construction are Development and Reform Commission, Ministry of Water Resources, Transportation Apartment, Environmental Protection Administration, Ministry of Forestry, Ministry of Land Resources, State Electricity Regulatory Commission and other several departments. Each of these departments has its own development plans, and each of them has its own sphere of jurisdiction. There are overlaps and influences among every department. There are contradictories between the regulations and requirements of each department.

3.2. There are conflicts of interest among related parties of hydropower projects

In upper Yangtze River, basin development companies have already been established in each major tributary. Different development subjects exists in the same river. It leads to the contradictions of the hydropower development rights and water allocation between up and down stream among hydropower development companies. It often crosses multiple countries, even crosses more than two provinces. The river at the location of hydropower station often locates the boundary of two provinces and two countries. The land covered by the reservoirs and dam location often separated in different provinces and countries. While the total tax revenue is a certain circumstances, the conflicts of interest among local governments in both banks and both streams are always exist. The conflicts of interest among local governments will lead to the hydropower station function can not be fully expiated.

3.3. The current tax system, electrovalent system and electric scheduling system are not conducive to the hydropower development

On one hand, the actual tax borne by hydropower companies is usually higher than most industrial and commercial sectors. It reduces the price competitiveness of hydropower and makes the self-accumulation and developments growing of hydropower companies reduce significantly. On the other hand, the

electricity price of the current hydropower station is the single price based on the cost. It cannot adequately value the service it provides. The electric resources should be unified planned and power grid merit should be constructed after optimization according to the optimized allocation of resources. If not, hydropower cannot find the way in a period of future time; the economic benefits of hydropower companies will decline significantly.

3.4. Reservoir Management Problems

Take Three Gorges Reservoir as the example, the resources development and environment protection of Three Gorges Reservoir are separated, and country and local government fragment the resource management and environment protection. It's hard to plan and coordinate and not conducive to the comprehensive utilization and ecological environment management of reservoirs^[4]. The management goal of the multiple departments in the reservoir management is single. It's lack of a unified reservoir management department. Otherwise, even a unified management system is established in the future, it should be avoided that only has the academic studying function but can't refer to the administrative and economic affairs. Otherwise, the basin organization and the local environment protection department, related department of multiple provinces can not command untidily, plan overall and management when facing the environment problems.

4. Management Systems of Large Hydropower Reservoirs in Upper Yangtze River

Facing the existing problems of hydropower development management of upper Yangtze River, a set of complete management system of hydropower reservoirs in upper Yangtze River is established in nine areas considering the characteristics of large hydropower reservoirs

4.1. The high-level coordination system of hydropower reservoirs in upper Yangtze River

Hydropower development is related to energy planning, electric power development, agriculture development, inner river transportation, environment protection directly. A high-level coordination department is needed to deal with the planning, construction and operation of large hydropower reservoirs. The Three Gorges Project can be regarded as a successful example, the hydropower construction committee led by the Prime Minister or Deputy Prime Minister, composed by related departments and the main leaders of the related provinces and engineering units is established as the coordinate department. There are specific offices to coordinate the land acquisition, immigration, environmental protection, conservation protection, tax sharing, financial support and other problems.

4.2. Basin comprehensive management system should be established to make for the development of hydropower reservoirs in upper Yangtze River

At present basin comprehensive management system should be established to make for the development of hydropower reservoirs. It includes the management of basin resources, environment, ecosystem, flood prevent and relevant economic social activities^[5]. At the national level, integrating the relevant functions of relevant department can be considered and the hydropower coordinate committee can be established. At the basin level, the comprehensive coordinate committee can be established by the united companies in the basin. Or basin management committee having the comprehensive coordinate and management function can be established.

4.3. Make and improve the safe, efficient regulatory and policy system of the hydropower reservoirs in upper Yangtze River

Currently, the laws and regulations of basin management should be improved, like enacting *River Basin Management Method*, *Wetland Law*. At the same time, the system and policy of basin management should be made and consummated: the first one is to make and consummate the planning system, such as comprehensive planning system, the professional planning system of water resource protection and water and soil conservation; the second one is to make and consummate the use and protection system of water resource, such as the unified scheduling system of water resource, impact assessment system of environment, ‘three simultaneous’ system, water using permit system, river management system and water and soil protecting system; the third one is to make and consummate the water pollution control system, such as pollution control system, sewage reporting system, sewage charging system, limit time system; the fourth one is to make and consummate the supervision and management of basins, such as target responsibility system, on-site inspection system and rewarding system.

4.4. Explore the multi-agent collaborative development model

he basin of upper Yangtze River is longer, it is more suitable for multi-agent collaborative development. The multi-agent collaborative development can raise the funds in a short period of time and speed up the development of hydropower development in upper Yangtze River, coordinate the benefits of multiple areas better, and overcome the drawbacks of single-agent development. It’s more competitive, and can improve the speed, quality and efficiency of hydropower development, maximum the overall effectiveness of river basin.

4.5. Make efficient compensative policy of cascade hydropower station

As ‘separate net and plant, electricity bidding’ is carried out gradually. Regulating reservoir will require more to share compensative benefits. National authorities should speed up the establishment of compensation income policies of hydropower station cascade. It is useful to mobilize the develop enthusiasm of hydropower stations, and it solves the benefit conflict among hydropower development companies. To solve the compensation problem of hydropower regulation benefits of up and down streams. A joint-stock basin development company can also be established by the jointly of several companies which gained the rights to develop the cascade hydropower station in up and down streams. The benefit conflict can be made ‘internalized’ in this way. By the inner coordinate of companies, it can solve water quality, electricity regulation and the benefits scheduling problems it brings. The hydropower companies share the benefits of basin companies according to the shares of the basin companies.

4.6. Establish reasonable two electrovalence mechanisms

National electrovalence system is established based on the long-term planned economy, and it does not play a catalytic role in accelerating the hydropower resource development. Hydropower bear peak modulation, frequency modulation, phase modulation, load, emergency reserve and other functions in power system. To reflect the power benefits and market competitiveness of hydropower stations, the power market reforms should accord to separate net and plant, electricity bidding and the same net, the same quality, the same price. Based on the two electrovalence used by large industrial users, the two electrovalence policy should be implemented in the electricity generating market to ensure the reasonable return of hydropower capacity benefits.

4.7. Make the efficient tax policy which does favor to the safety of hydropower reservoirs in upper Yangtze River

Before the value-added tax took in the hydropower, the ‘return when take’ of value-added tax in the transitional phase. The policy of value-added tax in Three Gorges is a kind of efficient system. Besides, the tax policy should be adjusted to increase hydropower development. The first one is to implement the preferential policy of tax. Refund the enterprise income tax of hydropower companies fully or partly, the return part is limited to the hydropower projects used to rolling development. The second one is to free or decrease part tax in the hydropower projects is building. For the farmland use tax, the immigration land in the reservoirs and the increase of comprehensive benefits of farmland should be considered. Considering the aggregate used in the hydropower construction is not belong to the business nature, the mineral resources tax and mineral resources compensation fees can be free, the import tariffs of mechanical and electrical used in the hydropower construction is free.

4.8. Study the macroscopical policy that can protect the electricity market space of hydropower reservoirs in upper Yangtze River

In order to ensure the electricity market space of hydropower reservoirs in upper Yangtze River, the demand of the electric power market should be forecasted in the perspective of national energy strategies. And it is used to make the middle-term plan of electric power, coordinate the development of hydropower and thermal. At the same time, the healthy integrity and restraint system should be established, the power supervisory board should perform the rights to punish the performance that against the planning and contract.

4.9. Research the management function and system of the large hydropower reservoirs in upper Yangtze River which joint development, operation, management

The Upper Yangtze River Basin Management Committee affiliated to the state council can be established. The management committee takes the basin management authority as the executive department, and the development department is changed to the basin management authority gradually. The full-basin company management mode that is purely economic nature is formed. The basin management committee has higher rights of resource and environment protection. The local departments are directed and coordinated by the committee in the management affairs. The implementing agencies has the rights to law enforce, coordinate, supervise and dispute water issues. The local department has the obligation to provide the scientific information and decision-making basis for the basin management committee and the implementing agencies

5. Conclusions

The Yangtze River is the longest river in China, and the upstream of it is the most important hydropower development base of our country. The number of the built and building large hydropower stations in upper Yangtze River is more than 60. The stations play a supporting role in the social economic development of China. There are lots of hydropower development departments and government management departments currently. It's lack of unified coordination mechanism. The hydropower development departments have their own development plan and jurisdiction. There are contradictions in hydropower development rights among companies and water quality schedule of hydropower stations in up and down streams. Facing these problems, combined the characteristics of hydropower reservoirs, the

high-level coordination mechanism of hydropower reservoirs should be established, the basin comprehensive management system benefited hydropower reservoirs should be made, the efficient regulations and policy system benefited hydropower reservoirs should be made and consummated, the multi-agent collaborative development model should be studied, the regulations on benefits-compensation of cascade hydropower station should be made, the reasonable two-part electric system should be established, the tax regulations which is beneficial to the safety and efficient of hydropower stations, the macro policy which protects the electric power market space of hydropower reservoirs. All of these provide useful references for the construction of hydropower reservoirs management system. Of course, this paper only does the preliminary discussions about different hydropower reservoirs management. The studies and practical work in this area need to be strengthening in the future.

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